

## 22.

Eastern Pacific Expeditions of the New York Zoological Society.  
XXI. Notes on Echinoderms from the West Coast  
of Central America.<sup>1</sup>

HUBERT LYMAN CLARK

*Museum of Comparative Zoology, Harvard University*

(Plates I & II; Text-figures 1-4).

[This is the twenty-first of a series of papers dealing with the collections of the Eastern Pacific Expeditions of the New York Zoological Society made under the direction of William Beebe. The present paper is concerned with specimens taken on the Eastern Pacific *Zaca* (1937-1938) Expedition, which was made possible through the generosity of Mr. Templeton Crocker. For data on localities, dates, dredges, etc., refer to *Zoologica*, Vol. XXIII, No. 14, pp. 287-298.]

## CONTENTS.

	Page		Page
Introduction .....	332	<i>Ophionereis annulata</i> (Leconte) .....	340
ASTEROIDEA		<i>Ophionereis nuda</i> Lütken & Mortensen .....	340
<i>Astropecten armatus</i> Gray .....	332	<i>Ophiocoma aethiops</i> Lütken .....	341
<i>Luidia asthenosoma</i> Fisher .....	332	<i>Ophiocoma alexandri</i> Lyman .....	341
<i>Luidia bellonae</i> Lütken .....	332	<i>Ophiopteris papillosa</i> (Lyman) .....	341
<i>Luidia foliolata</i> Grube .....	333	<i>Ophioderma panamense</i> Lütken .....	341
<i>Luidia ludwigi</i> Fisher .....	333	<i>Ophioderma teres</i> (Lyman) .....	342
<i>Oreaster occidentalis</i> Verrill .....	333	<i>Ophioderma variegatum</i> Lütken .....	343
<i>Nidorellia armata</i> (Gray) .....	333	<i>Diopederma danianum</i> (Verrill) .....	343
<i>Patiria miniata</i> (Brandt) .....	333	<i>Schizoderma diplax</i> Nielsen .....	343
<i>Linckia colombiae</i> Gray .....	334	<i>Ophiura lütkenii</i> (Lyman) .....	343
<i>Pharia pyramidata</i> (Gray) .....	334	<i>Ophiozона pacifica</i> (Lütken) .....	344
<i>Phataria unifascialis</i> (Gray) .....	334	Genus <i>Ophiolepis</i> .....	344
<i>Othilia aculeata</i> Gray .....	334	<i>Ophiolepis variegata</i> Lütken .....	344
<i>Sclerasterias alexandri</i> var. <i>crassa</i> var. nov. ....	335	<i>Ophiolepis fulva</i> sp. nov. ....	345
		<i>Ophiolepis grisca</i> sp. nov. ....	346
OPHIUROIDEA		ECHINOIDEA	
<i>Ophiomyxa panamensis</i> Lütken & Mortensen .....	336	<i>Eucidaris thouarsii</i> (Agassiz & Desor) .....	347
<i>Sigsbeia lineata</i> Lütken & Mortensen .....	336	<i>Stylocidaris dubia</i> (H. L. Clark) .....	347
<i>Amphiura arcystata</i> H. L. Clark .....	336	<i>Astropyga pulvinata</i> (Lamarck) .....	348
<i>Amphipholis geminata</i> (Leconte) .....	336	<i>Arbacia incisa</i> (A. Agassiz) .....	348
<i>Amphipholis platydisca</i> Nielsen .....	337	<i>Lytechinus anamesus</i> H. L. Clark .....	348
<i>Amphipholis squamata</i> (delle Chiaje) .....	337	<i>Lytechinus pictus</i> (Verrill) .....	348
<i>Amphichondrius granulatus</i> Nielsen .....	337	<i>Toxopneustes roseus</i> (A. Agassiz) .....	349
<i>Amphiodia sculptilis</i> F. Ziesenhene .....	337	<i>Strongylocentrotus purpuratus</i> (Stimpson) .....	349
<i>Amphiodia urtica</i> (Lyman) .....	338	<i>Echinometra vanbrunti</i> A. Agassiz .....	349
<i>Amphiodia vicina</i> sp. nov. ....	338	<i>Clypeaster europacificus</i> H. L. Clark .....	349
<i>Ophiactis savignyi</i> (Müller & Troschel) .....	339	<i>Clypeaster ochrus</i> H. L. Clark .....	350
<i>Ophiactis simplex</i> (Leconte) .....	340	<i>Clypeaster speciosus</i> Verrill .....	350
<i>Ophiothrix spiculata</i> Leconte .....	340	<i>Moira clotho</i> (Michelin) .....	350
<i>Ophiothela gracilis</i> Nielsen .....	340	<i>Plagiobrissus pacificus</i> sp. nov. ....	351
		<i>Meoma grandis</i> Gray .....	352
		<i>Lovenia cordiformis</i> A. Agassiz .....	352

<sup>1</sup> Contribution No. 602, Department of Tropical Research, New York Zoological Society.

## INTRODUCTION.

Aside from the holothurians, which I have not examined, the collection of Echinoderms which the *Zaca* made in 1937-38 consists of 822 specimens of 57 species, of which 73 specimens are sea-stars, 645 are brittle-stars and 104 are echini. Most of these are common forms and call for little comment, but a few are of notable interest and deserve a critical report. At least 4 species seems to be new to science, and 2 varieties are also treated as new.

It is a pleasure to thank Dr. William Beebe for the opportunity of studying this collection and for its deposit in the Museum of Comparative Zoology.

## ASTEROIDEA.

***Astropecten armatus* Gray.**

Gray, 1840. *Ann. Mag. Nat. Hist.*, 6, p. 181.

There are 24 specimens of this common sea-star from a dozen stations between Manzanillo, Mexico, and Hannibal Bank, Panama, in 2.5-60 fms. of water. Most of them are small, R=12-42 mm., but several have R exceeding 100 mm. and a notable specimen from Port Culebra, Costa Rica, has R=200-210 mm. This big one is dark yellowish-brown above and below, but the adambulacral armature and the tips of the superomarginal spines are conspicuously lighter. In this individual the superomarginal spines are fully developed, a complete double series extending from the interradial line to the tip of each ray. In no other adult specimen are both series complete, and much diversity is shown in their development. One small specimen (R=42 mm.) taken 14 miles south of Judas Point, Costa Rica, is very nearly referable to *A. californicus*, as the superomarginal spines are confined to the interbranchial arcs and there is a single pair only in each arc, the first superomarginal in each series having one small erect spinelet.

*Geographical Distribution:* San Pedro, California, to Punta Santa Elena, Ecuador; low water to 80 fms.

***Luidia asthenosoma* Fisher.**

Fisher, 1906. *Proc. Wash. Acad. Sci.*, 8, p. 124.

This species was not taken by the *Zaca* in 1936 but there is a single small specimen in the present collection, from Hannibal Bank, Panama, in 35-40 fms. The rays are only about 23 mm. long and 6 mm. wide. The color above is pale brown, variegated with whitish; beneath it is nearly white.

*Geographical Distribution:* Monterey, California, to Los Coronados Islands, L.C., Mexico; 11-339 fms.

***Luidia bellonae* Lütken.**

Lütken, 1865. *Vid. Med. Dansk. Nat. Foren.* 1864, p. 133.

There are 2 small but typical specimens of this species; one with R=75 mm., from 16 fms. in Chamela Bay, Mexico, and one, with R=100 mm., from 30 fms. off Manzanillo, Mexico.

*Geographical Distribution:* Gulf of California to Iquiqui, Chile; also Galápagos Islands; 2-30 fms.

**Luidia foliolata** Grube.

Grube, 1866. *Jahresber. schles. Ges. Vaterl. Cultur.* 1865, p. 59.

There are a dozen specimens of this well-known Californian species. The largest has R=140 mm. and br=27, but the others are much smaller and several are very badly damaged. They were taken at various stations between Tenacatita Bay, Mexico, and Corinto, Nicaragua, in 2-30 fms.

*Geographical Distribution:* Southeastern Alaska to Mazatlan, Mexico; 2-189 fms.

**Luidia ludwigi** Fisher.

Fisher, 1906. *Proc. Wash. Acad. Sci.*, 8, p. 122.

This interesting species is represented by 2 specimens taken east of Cedros Island, Lower California, in 45 fms. (St. 126 D-13, -14). In one R=only 37 mm. but the larger one has R=100 mm. They are alike in color, a reddish fawn, deepest along median area of each ray. It is interesting to note that the Zaca in 1936 secured 4 species of *Luidia* but although in 1937-38 she again took 4 species of the genus, only 2 are common to both collections.

*Geographical Distribution:* Monterey Bay to San Pedro, California; 15-50 fms.

**Oreaster occidentalis** Verrill.

Verrill, 1867. *Trans. Conn. Acad.*, 1, p. 278.

There are 3 specimens of this common species, 1 from a trap at Guatulco, Mexico, and 2 from Port Parker, Costa Rica. All are of moderate size with R=100-110 mm.

*Geographical Distribution:* Lower California to Ecuador; also Cocos and Galápagos Islands; low water to 50 fms.

**Nidorellia armata** (Gray).

*Pentaceros armatus* Gray, 1840. *Ann. Mag. Nat. Hist.*, 6, p. 277.

*Nidorellia armata* Verrill, 1867. *Trans. Conn. Acad.*, 1, p. 280.

Besides a normal 5-rayed specimen, with R=90 mm., from St. 200 D-28-30, at Corinto, Nicaragua, in 3 fms., there is a slightly smaller specimen from the same station, which has 5 rays orally but from above seems to have 6 rays; one ambulacral furrow when about 8 mm. from the mouth forks and a ray has developed in association with each division. These 2 rays, however, are only about 50 mm. long, while the 4 other rays have R=83 mm.

*Geographical Distribution:* Guaymas, Mexico, to Zorritos, Peru; also Galápagos Islands; low water to 40 fms.

**Patiria miniata** (Brandt).

*Asterina miniata* Brandt, 1835. *Prodromus*, p. 68.

*Patiria miniata* Verrill, 1914. *Harriman Exp. Sea-stars*, p. 264.

This northern species is represented by a single very small specimen taken at St. 126 D-19, southeast of Cedros Island, Lower California, in 25 fms. It has 5 rays, with R=8 mm. and might well be called in the *Asterina* stage.

*Geographical Distribution:* Sitka, Alaska, to Gulf of California; low water to 165 fms.

**Linckia colombiae** Gray.

Gray, 1840. *Ann. Mag. Nat. Hist.*, 1, p. 285.

A single small 6-armed specimen, scarcely 5 mm. across the disk but with  $R=40$  mm., more or less, represents this common species. It was taken, with the preceding, at St. 126 D-19, southeast of Cedros Island, Lower California, in 25 fms.

*Geographical Distribution*: San Pedro, California, to Colombia; also Galápagos Islands; low water to 55 fms.

**Pharia pyramidata** (Gray).

*Ophidiaster pyramidatus* Gray, 1840. *Ann. Mag. Nat. Hist.*, 1, p. 284.

*Pharia pyramidata* Sladen, 1889. "Challenger" *Asteroidea*, p. 784.

A half a dozen specimens with  $R$  ranging from 50 to 90 mm., were taken at Tenacatita and Sihuatanejo Bays, Mexico, and Port Parker and Uvita Bay, Costa Rica.

*Geographical Distribution*: Gulf of California to Zorritos, Peru; also Galápagos Islands; low water to 10 fms.

**Phataria unifascialis** (Gray).

*Linckia unifascialis* Gray, 1840. *Ann. Mag. Nat. Hist.*, 1, p. 285.

*Phataria unifascialis* Sladen, 1889. "Challenger" *Asteroidea*, p. 786.

Of the 14 specimens, with  $R$  ranging from 15 to 87 mm., few call for comment. They were taken at Tenacatita and Sihuatanejo Bays, Mexico; Cardon Isl. at Corinto, Nicaragua; Uvita Bay, Costa Rica, and Bahia Honda, Panama. The specimen from Corinto is a very fine one with  $R=87$  mm. and  $br=11$ . The one from Uvita Bay is very odd, for each ray has been bitten or broken off at the tip and then more or less regenerated; the longest is only 46 mm. long but it is 12 mm. broad. The color is definitely yellow.

*Geographical Distribution*: Gulf of California to Zorritos, Peru; also Galápagos Islands; low water to 10 fms.

**Othilia aculeata** Gray.

Gray, 1840. *Ann. Mag. Nat. Hist.*, 1, p. 281.

Plate I, figs. 1 & 2.

At Corinto, Nicaragua, St. 200 D-5,-6,-7, in 2-2.5 fms., the *Zaca* dredged 4 specimens of an echinasterid, which are apparently examples of this long lost species. Although described almost a century ago it has never since been taken and no specimens are known to be extant. It is therefore extraordinarily interesting that the *Zaca* should have secured these 4 individuals. Gray's specimens were from Guacamayo, Central America, fine sand, 13 fms., and apparently were larger than any of these from Costa Rica. As he gives no measurements, however, and only a very brief and imperfect description, much has to be inferred in regard to the types. It is worth while therefore to give some details about the *Zaca* specimens.

The smallest specimen, now dry, has  $R=14$  mm.;  $r=3$  mm. and  $br$  is the same. There are 6 relatively large spines on the disk, the central one the smallest. On each ray there are about 7 such spines in three indefinite series of 2 or 3 each. Many minute spinelets are scattered here and there, mostly on the distal half of each arm. All the larger skeletal plates have, in this dry specimen, a shagreen-like surface. Color light gray-brown with the tips of the large spines and the lower surface pale yellow.

A second specimen has  $R=21$  mm. with  $r=5$  mm. and  $br=4.5$ . The color is as in the smaller specimen. There are about 5 big spines in each of three series on each arm, and 4 or 5 similar but somewhat smaller spines on the disk. There are very few minute spinelets except near tip of each arm.

The third specimen is nicely preserved in alcohol. It has  $R=28-30$  mm.,  $r=7$ ,  $br=6$ . The body surface is very smooth with scarcely any small spinelets except at very tip of arm and here and there on oral surface of distal part of arm. There are about 20 of the big spines on each ray, and 7 or 8 on the disk. On the rays there are marginal series of 5 or 6 spines, an irregular median dorsal and an incomplete lateral on each side; these 3 series having 3-5 spines each. The color is quite different from the dried specimens; it is more or less definitely brown on the sides of the arms, where it is darkest, but dorsally it is fawn-color and orally nearly buff or yellowish; the spines are lightest at tip.

The largest specimen (Plate I, figs. 1 & 2) is dried from alcohol and its color is dull yellow-brown with the papular areas a darker brown.  $R=33-35$  mm.,  $r=8$  and  $br$  is also 8. There are about 5 rather indefinite series of big, nearly white, spines (2-5 mm. long) on each ray. Papulae are conspicuous; on the oral surface they chiefly occur singly; on sides of ray, there are 2 or 3 in a group, while aborally there are up to 8-10 in each area. Aborally there are a very few widely scattered minute spinelets; 6-8 of these are on the carinal ridge at the very tip of each arm. On distal half of arm there are a very few small spines scattered on the sides and oral surface. Adambulacral spines in 3 more or less distinct series; innermost, minute curved spinelets well up in furrow; on furrow margin a series of pointed spinelets, a millimeter long; outside these is a series of similar but frequently stouter spinelets, but this series is not so nearly complete as the marginal one.

Although these specimens are probably all young, they are noticeably distinct from any of the better known sea-stars of the Panamic region. The largest was submitted to Dr. W. K. Fisher, the world's authority on sea-stars, who kindly had the best possible photographs made (by Mr. B. B. Fisher) and permits me to publish them herewith. He believes it is justifiable to refer these specimens to Gray's long-lost species. Mr. Dilwyn John, of the British Museum, assures me that Gray's specimens are no longer extant, although their fate is unknown. They are described as having 7 series of large spines on the arms, indicating that they were considerably larger than the largest of the *Zaca* quartette, as previously stated. All efforts to locate "Guacamayo" have proved futile but as Gray states that Hugh Cuming, Esq., was the collector, and Cuming is not known to have collected on the eastern coast of Central America, we are justified in believing that the original specimens of *aculeata* were from the western coast.

*Geographical Distribution:* Prior to *Zaca* collection, known only from a single station on the western coast of Central America, the location of which is unknown.

#### ***Sclerasterias alexandri* var. *crassa* var. nov.**

A single small sea-star from St. 126 D-19, southeast of Cedros Island, Lower California, in 25 fms. caused me so much perplexity that I sent it to Dr. Fisher who very kindly made a careful study of its important features and wrote me: "I would list this as a variation of *S. alexandri*." It differs "from the type of *alexandri* in having coarser spines and constantly diplanthid adambulacrals." However "the coarseness of spines is usually quite variable in *Coscinasterinae*." "There is a well-developed web between outer inferomarginal spines which in *S. heteropaea* is practically absent. The

crossed pedicellariae are like those of *alexandri* in size and shape." In color, "*heteropaes* is gray-green; *alexandri*, red-brown."

This interesting specimen, which may be designated as the holotype of var. *crassa* (M.C.Z. No. 3753) has a disk 6 mm. across and short, stout arms only 20 mm. long, 4 mm. in actual diameter at base, but 7 mm. wide on the actinal side, when the inferomarginal spines are included. As in typical *alexandri* there are but 3 series of abactinal spines, a carinal and on each side a superomarginal. These spines are shorter, stouter and blunter than in typical *alexandri*. The skeleton is much coarser and the papular areas very much smaller and less conspicuous than in the cotypes of *alexandri* with which it has been compared. The color is a deep red-brown above, much darker than these types. These differences combine to give it a markedly different facies from that of Ludwig's types. As there is but one specimen, however, and that obviously young, it seems best to list it simply as a variety, but more and larger specimens will probably justify its recognition as a distinct species. It is strikingly different from *heteropaes*, the only other *Sclerasterias* from the western coast of America.

*Geographical Distribution*: Bay of Panama; 52-210 fms. The variety *crassa* is known only from the *Zaca* specimen.

#### OPHIUROIDEA.

### ***Ophiomyxa panamensis* Lütken & Mortensen.**

Lütken & Mortensen, 1899. *Mem. M.C.Z.*, 23, p. 182.

At Station 126 D-19, off Cedros Island, Lower California, in 25 fms. of water, 4 small adults of this brittle-star were taken, while a very young one, only 5 mm. across the disk, was collected at St. 224 D-1,-2,-3, on Hannibal Bank, Panama, in 35-40 fms.

*Geographical Distribution*: Gulf of California to Panama; also Cocos and Galápagos Islands; 25-85 fms.

### ***Sigsbeia lineata* Lütken & Mortensen.**

Lütken & Mortensen, 1899. *Mem. M.C.Z.*, 23, p. 183.

A single small adult was collected at St. 224 D-2,-3, on Hannibal Bank, Panama, in 35 fms. It is nearly white now, but the brown lines on the disk can still be detected.

*Geographical Distribution*: Cocos and Galápagos Islands; 30-100 fms.

### ***Amphiura arcystata* H.L. Clark.**

H. L. Clark, 1911. *Bull. 75, U.S.N.M.*, p. 145 (printed *acrystata* by error).

A very small specimen, 4.5 mm. across the disk, was dredged in 38 fms., off Maldonado Point, Mexico, at St. 192 D-3. It is now white with the naked skin of the disk, yellowish-brown.

*Geographical Distribution*: Japan and California to Gulf of California; 30-330 fms.

### ***Amphipholis geminata* (Leconte).**

*Ophiolepis geminata* Leconte, 1851. *Proc. Acad. Nat. Sci. Phila.* 5, p. 317.

*Amphipholis geminata* Ljungman, 1867. *Öfv. Kongl. Vet. Akad. Förh.*, 23, p. 313.

This very long-armed brittle-star\* seems to be common in the Gulf of Fonseca, El Salvador, and in the Gulf of Nicoya, Costa Rica. There are 27 specimens at hand from St. 199 D-1,-17-25, and 3 from St. 213 D 13-17. A muddy bottom in shallow water is the chosen habitat.

*Geographical Distribution*: Panama (Pacific side); low water to 5 fms.

***Amphipholis platydisca* Nielsen.**

Nielsen, 1932. *Vid. Med.* 91, p. 290.

There are 11 specimens of this fine big *Amphiodia*-like species, taken at the same stations as the preceding; St. 199 D-7-16; St. 213 D-12-17; and St. 214 D-1-4. Only 3 have the disk which is about 10 mm. across, still attached to the mouth frame and the smallest of these is a typical example of Nielsen's variety *microplax*. It is odd that Nielsen did not realize that his supposed variety is based on an individual with a regenerating disk.

Apparently *platydisca* is one of those amphiuroids which shed the disk, when mature, on very slight provocation. It may be that the shedding is the normal process of setting free ova and spermatozoa. But, at any rate, the present series of specimens shows that at the time and place when they were taken shedding was twice as frequent as retention. Nielsen's material was from Panama, so that the present series extends the range considerably to the northward.

*Geographical Distribution*: Panama (Pacific side); low water to 15 fms.

***Amphipholis squamata* (delle Chiaje).**

*Asterias squamata* delle Chiaje, 1828. *Mem. Anim. sans Vert. Napoli*, 3, p. 74.

*Amphipholis squamata* Verrill, 1899. *Trans. Conn. Acad.* 10, p. 312.

This small but wellnigh ubiquitous brittle-star is represented by a young individual from St. 126 D-19 (Lower California, southeast of Cedros Island, 25 fms.) and a still smaller specimen, only 2 mm. across the disk from *Pocillopora* coral, Jasper Island, Gulf of Nicoya, Costa Rica, 1 fm.

*Geographical Distribution*: Cosmopolitan; low water to 100 fms.

***Amphichondrius granulosis* Nielsen.**

Nielsen, 1932. *Vid. Med.*, 91, p. 304.

At St. 192 D-3, off Maldonado Point, Mexico, in 38 fms. on a muddy bottom, 2 specimens of this interesting species were taken. The larger is only 5 mm. across the disk and hence is little more than half grown but the generic features are unmistakable.

*Geographical Distribution*: The species was known hitherto only from the vicinity of La Jolla and San Diego, California.

***Amphiodia sculptilis* F. Ziesenhenné.**

F. Ziesenhenné, 1940. *Allan Hancock Pac. Exp.*, 8, No. 2, p. 24.

A single young specimen of this fine species was taken at St. 200 D-1,-3,-8, in 2-6.6 fms. at Corinto, Nicaragua, on a mangrove-leaves bottom. It was previously known from various stations on the western coast of Mexico. This individual is about 3.5 mm. across the disk and the arms are some 25 mm. long. The general color is dark gray but the oral region and the accompanying arm spines are cream. The single large tentacle scale is very distinctive.

*Geographical Distribution*: Western coast of Mexico; 5-20 fms.

***Amphiodia urtica* (Lyman).**

*Amphiura urtica* Lyman, 1860. *Proc. Boston Soc. Nat. Hist.*, 7, p. 258.

*Amphiodia urtica* Verrill, 1899. *Trans. Conn. Acad.*, 10, p. 313.

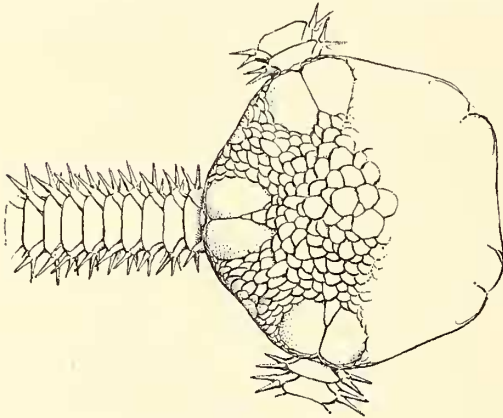
A single adult specimen, 6.5 mm. across the slightly elevated disk, was taken at St. 196 D-14, in Tangola-Tangola Bay, Mexico, in 5 fms. on a shelly bottom, thus extending the range considerably to the south.

*Geographical Distribution*: Shumagin Islands, Alaska, to Lower California; 15-50 fms.

***Amphiodia vicina*<sup>2</sup> sp. nov.**

(Text-figures 1 & 2).

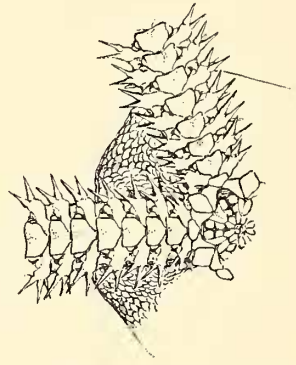
Disk 10 mm. in diameter, nearly circular and rather flat. Arms 5, 80-90 mm. long, rather stout basally, about 2 mm. wide regardless of the arm-spines, tapering very gradually to the not very attenuate tip. Disk covered by a coat of rather coarse overlapping scales without clearly indicated primary plates; the largest ones more than half a millimeter across; very few are even approximately circular, some are quite angular and some distinctly elongated; in each interradius there are 7-9 series separating the pairs of radial shields. These shields are about 3 mm. long, 1.5 mm. wide distally; they are in contact for one-half or more of their inner margins but proximally are separated by one large, long triangular scale or by 2 or more smaller ones. Upper arm-plates wider than long; basally the width is almost thrice the length and even far distally the length does not quite equal the width. On the basal part of the arm, the distal margin of each plate is much longer than the proximal, the resulting lateral angles being more or less rounded, although often very acute, and more or less of the upper end of the side arm-plates being conspicuous between them. On the basal part of the arm there is a slight but usually rather distinct keel or ridge along the mid-line.



Text-figure 1.

*Amphiodia vicina*. Upper surface.

× 6.



Text-figure 2.

*Amphiodia vicina*. Lower surface.

× 6.

Interbranchial areas closely covered, like the disk, by coarse overlapping scales; the uppermost or marginal scales stand on edge and form a low marginal "fence" around the disk, somewhat suggestive of *Ophiophragmus*; genital slits long, reaching nearly to the disk margin. First under arm-plate

<sup>2</sup> *vicinus*—neighboring, in reference to its nearness to *A. psara*, both structurally and geographically.



small, rounded, swollen, rather wider than long; second and succeeding plates rounded pentagonal, wider than long; the second and third plates have the lateral and distal margins concave, but this is not evident on the following plates; these plates are not quite in contact, yet the side arm-plates seldom meet in the mid-line; as a consequence there is generally the indication of a pit in the mid-line between the under arm-plates; the basal plates, especially the second and third, have the margins thickened or even a little swollen. Side arm-plates rather large and projecting but they do not actually meet either above or below, even distally; each carries 3 arm-spines, about a millimeter long, subequal or the middle one a little the longest; slightly swollen at base but tapering somewhat abruptly to a slender, if not acute, point. Tentacle-scales 2, rather large, subequal; as usual in such cases one is borne on the under arm-plate and one on the side arm-plate.

Oral shields spear-head shaped, longer than wide, with scarcely rounded angles, the madreporite a trifle larger than the others and slightly swollen. Adoral plates trigonal, slightly swollen, just meeting within, the inner margin concave, the other two straight. Oral papillae 3 on each side; those at the apex of the jaw are narrow and notably longer than wide, quite separated from each other; the second papilla tends to show some diversity in form, being flattened and somewhat angular, or rounded and scale-like, about as wide as long; the distal papilla is largest and most scale-like and is carried on the adoral plate. Teeth few, small and block-like.

Color of preserved specimens, now dry, light gray with a lavender tint, variegated with light cream-color or white; many disk scales are white in the holotype and in the smallest specimen but this is less evident in the others; each radial shield has a more or less conspicuous blotch of white or whitish on the distal half; oral surface very light; the under arm-plates and arm spines nearly white.

Holotype, M.C.Z. No. 6026, from St. 213 D-13, off Ballenas Bay, Gulf of Nicoya, Costa Rica, 35 fms., mud.

There are 12 paratypes from the same locality, (St. 213 D-13,-14,-15,-16; 35-45 fms.). One of these is remarkable for being symmetrically tetramerous; as the arms are 100 mm. long, it is obviously a large adult, but as the disk is missing little more can be said about it; the characters shown by arms and mouth-parts are entirely like those of the holotype. Another specimen worthy of mention is the smallest. It has a disk 7 mm. across with the scales scarcely overlapping and hence smoother and flatter than in the large individuals.

This is a well-marked species for while it reminds one of *psara* (H. L. Clark, 1935. *Ann. Mag. Nat. Hist.* (10) 15, p. 127) the difference in the upper arm-plates is very striking, and the arm-spines and under arm-plates are also different. Furthermore the oral papillae of *psara* are much stouter and the distal one in particular is much larger than in *vicina*. Whether the areas occupied by the two species overlap remains to be seen. So far as I know, *psara* has not been taken south of Acapulco.

*Geographical Distribution*: Known only from the *Zaca* collection.

### ***Ophiactis savignyi* (Müller & Troschel).**

*Ophiolepis savignyi* Müller & Troschel, 1842. *Sys. Ast.* p. 95.

*Ophiactis savignyi* Ljungman, 1867. *Öfv. Kongl. Vet. Akad. Förh.*, 23, p. 323.

This very common brittle-star is represented by 17 specimens, mostly small, but several of those taken at St. 195 D-5, are adults 6 mm. across disk, although all of this lot regardless of size have 6 arms. All of the material

was collected at St. 195 in Port Guatulco, Mexico, save 2 small specimens found at Cardon Island, Corinto Bay, Nicaragua.

*Geographical Distribution*: Tropicopolitan; low water to 27 fms.

### ***Ophiactis simplex* (Leconte).**

*Ophiolepis simplex* Leconte, 1851. *Proc. Acad. Nat. Sci. Phila.*, 5, p. 318.

*Ophiactis simplex* Lütken, 1859. *Add. ad Hist. Oph.* pt. 2, p. 130.

There are 4 very young specimens of this little *Ophiactis* from St. 126 D-19, east of Cedros Island, Mexico, in 125 fms.

*Geographical Distribution*: La Jolla, California, to Balboa, Canal Zone; low water to 5 fms.

### ***Ophiothrix spiculata* Leconte.**

Leconte, 1851. *Proc. Acad. Nat. Sci. Phila.*, 5, p. 318.

There are 78 specimens of this very common brittle-star, the largest 12 mm. across the disk. Most of them are dull gray-blue or purplish but those from St. 184 are very light colored, a pale grayish-brown, and those from St. 126 are also very light but with a reddish tint, the disk quite rosy or in the largest one a deep crimson in sharp contrast to the arms. This species was taken at the following stations: 126 D-19, southeast of Cedros Island, Mexico, 25 fms.; 184 D-2, off Manzanillo, Mexico, 30 fms.; 199 D-7-16, La Union, El Salvador, 5-6 fms.; 200 D-5-7, 28-30, Corinto, Nicaragua, 2-3 fms.; 218 D-5, Golfito, Costa Rica, 6 fms. There are 50 specimens taken from *Pocillopora* coral, Jasper Island, Gulf of Nicoya, Costa Rica, 1 fm.

*Geographical Distribution*: Monterey Bay, California, to Bay of Sechura, Peru, also Galápagos Islands; low water to 45 fms.

### ***Ophiothela gracilis* Nielsen.**

Nielsen, 1932. *Vid. Med.*, 91, p. 256.

There are 3 small 5-armed *Ophiothelas* which I refer with some hesitation to this species, on small fragments of a gorgonian from a tide-pool at Uvita Bay, Costa Rica. The largest is only 2 mm. across the disk. The genus needs critical study and revision.

*Geographical Distribution*: Panama; 4-5 fms.

### ***Ophionereis annulata* (Leconte).**

*Ophiolepis annulata* Leconte, 1851. *Proc. Acad. Nat. Sci. Phila.* 5, p. 317.

*Ophionereis annulata* Lyman, 1860. *Proc. Bost. Soc. Nat. Hist.*, 7, p. 203.

Half a dozen specimens were taken at Uvita Bay, Costa Rica, and a single specimen at Bahia Honda, Panama.

*Geographical Distribution*: San Diego, California, to Panama; also Galápagos Islands; low water to 20 fms.

### ***Ophionereis nuda* Lütken & Mortensen.**

Lütken & Mortensen, 1899. *Mem. M.C.Z.*, 23, p. 163.

A single small specimen, scarcely 5 mm. across the disk, was taken at St. 224 D-1, -2, -3, on Hannibal Bank, Panama, in 35-40 fms.

*Geographical Distribution*: Isabel Island, Mexico, to Gulf of Panama; also Galápagos Islands; low water to 85 fms.

***Ophiocoma aethiops* Lütken.**

Lütken, 1859. *Add. ad Hist. Oph.*, pt. 2, pp. 141, 145.

There is an adult specimen of this abundant Panamic brittle-star taken from coral, Arriba Isthmus, Port Parker, Costa Rica. It is 20 mm. across the light gray disk, which is irregularly speckled with deep brown. A small adult with all arms broken off near the base but each obviously regenerating, and 2 young specimens were collected in Bahía Honda, Panama. There are 9 specimens from St. 195 D-15, in Port Guatulco, Mexico, 1.5 fms., and there is a single specimen from an unknown station.

*Geographical Distribution*: Lower California to Panama; also Cocos and Galápagos Islands; low water to 10 fms.

***Ophiocoma alexandri* Lyman.**

Lyman, 1860. *Proc. Boston Soc. Nat. Hist.*, 7, p. 256.

This common long-armed brittle-star is represented by two lots of quite different appearance. From an unknown station, there are 9 adults, 10-15 mm. across the disk, with the usual brown coloration, the arms banded with a darker shade. There is no indication of green. The other lot was taken at St. 195, D-15, in Port Guatulco, Mexico, 1.5 fms., and consists of 22 specimens, ranging from 5 to 15 mm. across the disk with arms 7 times as much. They are notable for their unusual coloration. In the smallest specimen, the ground color is a very deep green, lightest near arm-tips, with more or less indefinite markings of a light shade. In larger specimens the disk is more brown and in the adults it is a definite uniform brown, (in one case almost deep yellow) with a green tinge around the margin. The arms are brown at base but green distally, irregularly but definitely banded with a darker shade. The shade and extent of the green show great diversity in different individuals, but the arm-spines are in all cases quite green with the tips often perceptibly lighter. The under arm-plates are green (or at base of arms, brown) on the margins but a broad light area covers the middle; as a result the under side of the arm appears to be brown (basally) or green, with a broad longitudinal light stripe along the middle. This type of coloration is frequent in specimens from the Galápagos Islands.

*Geographical Distribution*: Lower California to Panama; also Cocos and Galápagos Islands; low water to 10 fms.

***Ophiopteris papillosa* (Lyman).**

*Ophiocoma papillosa* Lyman, 1875. *Illus. Cat. M.C.Z.*, No. 8, pt. 2, p. 11.

*Ophiopteris papillosa* McClendon, 1909. *Univ. Cal. Publ. Zool.*, 6, p. 49.

A young individual, scarcely 5 mm. across the disk and light grayish-brown in color, was collected at St. 126, D 19, in 25 fms., southeast of Cedros Island, Lower California.

*Geographical Distribution*: Carmel Peninsula, California, to Todos Santos Bay, L.C., Mexico; low water to 50 fms.

***Ophioderma panamense* Lütken.**

Lütken, 1859. *Add. ad Hist. Oph.*, pt. 2, p. 91.

There are 12 specimens of this common brittle-star, ranging from 9 to

19 mm. across the disk. They show some diversity in color from gray and brown to more or less olive-green; the arms are banded in all at least distally, and this is the best distinction from *teres*. They were taken at St. 195 (Port Guatulco, Mexico), at Cardon Island, Corinto Bay, Nicaragua, and at Port Parker, Ballenas Bay and Uvita Bay, Costa Rica, always in very shallow water. Two specimens were taken in *Pocillopora* coral, Jasper Island, Gulf of Nicoya, Costa Rica, 1 fm.

*Geographical Distribution*: San Pedro, California, to Payta, Peru; also Cocos and Galápagos Islands; low water to 10 fms.

### **Ophioderma teres** (Lyman).

*Ophiura teres* Lyman, 1860. *Proc. Boston Soc. Nat. Hist.*, 7, p. 198.

*Ophioderma teres* Meissner, 1901. *Bronn's Thier-reichs*, 2, pt. 3, p. 915.

The examination of the Ophiodermas brought back by the *Zaca* revealed the interesting fact that the 8 specimens to be referred to *teres* fall into two easily distinguished groups. One of these is made up of unicolored individuals, usually very dark. The other consists of individuals having the dull purplish upper arm-plates more or less conspicuously spotted with light buff or cream-color; the disk is also more or less conspicuously spotted with the same light shade. Moreover the lower surface of the arms, including the lowest arm-spines, is white or pale yellowish, in marked contrast to the dull interbrachial areas and sides of the arms. A re-examination of Lyman's original description shows that his type of *teres* was one of these spotted individuals, which are strikingly different from *panamense*. Unfortunately however the unicolored specimens are not so easily distinguished but seem to intergrade with *panamense*. Nielsen (1932) suggested as the best distinction between them that in adult *teres* many upper arm-plates (usually all or nearly all) are broken into two or more irregular fragments. This fragmentation may occur in *panamense* but only in a few plates. Unfortunately it is often insignificant in young *teres*. Usually *panamense* is grayish or greenish or brown with more or less conspicuously banded arms. It is never speckled as is typical *teres*, which also lacks any bands on the arms. The unspeckled form of *teres*, which apparently seldom occurs with the typical form, is often very dark brown and the lower surface of the arms (except maybe near the disk) is not notably lighter. The arms are however rarely banded distally and then only in small specimens; of course such specimens are hard to tell from *panamense* but in *teres* the light band consists of a short longitudinal white streak on each side of 3 or 4 segments separated by a narrow dark line. In *panamense* the light bands are more diffuse and variegated. On the whole the atypical form of *teres* needs a distinctive name and may well be called variety *unicolor*. A specimen from the Galápagos Islands, 35 mm. across the disk, M.C.Z. No. 114, may be designated as the type. A very similar specimen, 31 mm. across the disk, is in the present collection from Cardon Island, Corinto, Nicaragua, accompanied by 2 smaller specimens, one only 10 mm. across the disk.

The specimens of typical *teres* in the *Zaca* collection are from the Arriba Isthmus and Abajo Isthmus, Port Parker, Costa Rica. The largest is 32 mm. across the disk. A small specimen was taken in *Pocillopora* coral from Jasper Island, Gulf of Nicoya, Costa Rica, 1 fm.

*Geographical Distribution*: Gulf of California to Panama; also Galápagos Islands; low water to 10 fms.

**Ophioderma variegatum** Lütken.

Lütken, 1856. *Vid. Med.*, p. 21.

This slender-armed and often brightly colored species is easily recognized by the naked adoral plates yet it is often confused with *panamense*. There are 5 specimens at hand, not notable in any way. They are all dull grayish-green above with banded arms and the oral area nearly or quite white; the under surface of the arms is also nearly white in the largest specimen, which is 13 mm. across the disk. In 2 of the specimens, a conspicuous light gray area covers more or less of the disk. This quintet were taken at St. 200, Corinto, Nicaragua, on mangrove leaves, in 2-3 fms.

Notably different are 10 specimens from St. 195 D-17, -18, Port Guatulco, Mexico, on sand in 6 fms. These are white beneath and strikingly variegated above with green, rose-red and cream-color, and light and dark dusky shades. There are 7 similar specimens from St. 196, Tangola-Tangola Bay, Mexico, 7-10 fms., and a single large individual, 15 mm. across the disk, from St. 182 D-4, Chamela Bay, Mexico, in 16 fms. on sand. There are also 2 small specimens from St. 213 D-6, -7, -8, -9, off Cedro Island, Costa Rica, 4-6 fms.

*Geographical Distribution*: San Diego, California, to Panama; also Cocos Island; low water to 60 fms.

**Diopederma danianum** (Verrill).

*Ophiura danianum* Verrill, 1867. *Trans. Conn. Acad.*, 1, p. 254.

*Diopederma danianum* H. L. Clark, 1913. *Bull. Amer. Mus. Nat. Hist.*, 32, p. 206.

This characteristic brittle-star of the western coast of Central America is represented by 30 specimens, ranging from 9 to 26 mm. in disk diameter. They were taken at the following stations: St. 183 D-2, Tenacatita Bay, Mexico, 30 fms.; St. 195 D-20, -21, Port Guatulco, Santa Cruz Bay, Mexico, 18-23 fms.; St. 196 D-6, Tangola-Tangola Bay, Mexico, 7 fms.; St. 197 D-2, 7 miles west of Champerico, Guatemala, 14 fms.; St. 198 D-1, -2, La Libertad, El Salvador, 13-14 fms.; St. 199 D-1, Gulf of Fonseca, El Salvador, 16 fms.

*Geographical Distribution*: Lower California and Cocos Island to Panama; 3-25 fms.

**Schizoderma diplax** Nielsen.

Nielsen, 1932. *Vid. Med.*, 91, p. 335.

This remarkable ophiuran was taken by the *Zaca* in 1938, only at St. 214 D-1, -2, -3, -4, 14 miles southeast of Judas Point, Costa Rica, on a bottom of mud and shell in 42 fms. There are 19 specimens ranging from 6 to 11 mm. in disk diameter.

*Geographical Distribution*: Lower California to Panama; low water to 60 fms.

**Ophiura lütkenii** (Lyman).

*Ophioglypha lütkenii* Lyman, 1860. *Proc. Boston Soc. Nat. Hist.*, 7, p. 197.

*Ophiura lütkenii* Meissner, 1901. *Bronn's Thier-reichs*, 2, pt. 3, p. 925.

This northern brittle-star was found at St. 126 D-13, in 45 fms., east

of Cedros Island, Lower California, the southern limit of its range so far as yet known. The 8 specimens are all small, only about 8 mm. across the disk.

*Geographical Distribution*: Alaska to Lower California; 15-100 fms.

### **Ophiozona pacifica** (Lütken).

*Ophiolepis pacifica* Lütken, 1856. *Vid. Med.*, p. 22.

*Ophiozona pacifica* Lyman, 1865. *Illus. Cat. M.C.Z.*, 1, p. 64.

There are 2 small adults of this species in the collection, both taken in *Pocillopora* coral from Jasper Island, Gulf of Nicoya, Costa Rica, 1 fm.

*Geographical Distribution*: Previously known only from the Gulf of Panama; low water to 10 fms.

### Genus *Ophiolepis*.

This genus is represented by 318 specimens ranging from 1½ to 24 mm. in disk diameter. As none of them can be properly referred to either *crassa* or *plateia*, it would be natural to refer them to the third West Coast species, the long-known *variegata*. But even a superficial examination shows this to be an utterly erroneous procedure. Yet patient and long-continued study has failed to discover a natural or satisfactory grouping. Aside from those more or less adult specimens which are unquestionably *variegata*, there are two groups, very unlike each other, which are so different from *variegata*, it seems most natural to consider them distinct species. Unfortunately this does not clear up the matter, as there are still many specimens, 9 mm. or less in disk diameter, which cannot be referred definitely to any one of the 3 species. These specimens seem to be young *variegata* but most of them are so unlike small specimens which are undoubtedly that species that one cannot be wholly satisfied to call them *variegata*. It seems best to include them for the present under that species, to which attention may now be given.

### **Ophiolepis variegata** Lütken.

Lütken, 1856. *Vid. Med.* p. 23.

From St. 182 D-4, in Chamela Bay, Mexico, 16 fms., there are 7 very good typical examples of this handsome species, 10-17 mm. across the disk; the arms are 3 times the disk diameter. There are usually 3 arm-spines, the lowest the smallest and the uppermost largest, but at the base of the arm in the larger specimens there may be 4 spines and if so the uppermost may be the smallest; the spines are usually quite sharply pointed but in the larger specimens they may be thick clear to the tip and with a rather blunt point.

From St. 184 D-2, at Manzanillo, Mexico, 30 fms., and from St. 195 D-17-20, in Port Guatulco, Mexico, 6-23 fms., there are 38 specimens, 7-15 mm. across the disk, very similar in all respects to those from St. 182, but in the smallest there are but 2 arm-spines on most of the arm-segments near the middle of the arm, the upper one the larger, while basally and distally there are 3 as usual. From this same station, 195 D 17-20, there are 69 specimens, which I cannot determine satisfactorily but which I am for the present considering young *variegata*. They differ obviously from typical young individuals of the same size, in that the disk is very flat and thin and nearly or quite circular, instead of being higher than the arm-bases and definitely pentagonal. The arm-spines are usually 2 but on some part of the arm, *often far distal*, there are 3 as in typical *variegata*. Orally there are no tangible, constant differences. In color, the small flat individuals are much more variegated than typical *variegata*, the disk and arm-plates them-

selves being blotched, mottled or speckled in marked contrast to the solidly colored plates and scales of the typical form. The banding of the arms may be almost entirely wanting or, at best, quite indistinct in these odd, youthful, individuals, which are 6.5-9 mm. across the disk.

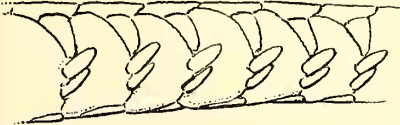
From St. 196 D-6, 13-15, in Tangola-Tangola Bay, Mexico, 5-10 fms., there are 8 specimens which are clearly *variegata*. The smallest is only 3 mm. across the disk and has only 2 arm-spines on each side arm-plate, but the scaling of the disk and its coloring are quite typical. In 3 individuals 5-7 mm. across, the disk is very similar but there are 3 arm-spines on many segments. The remaining 4 specimens are 12-16 mm. across the disk and often have 4 arm-spines basally. From this same station there are 21 small individuals, 4-10 mm. across the disk, which are like the perplexing lot described above from St. 195. Although they are here included under *variegata*, I am not satisfied with that identification.

*Geographical Distribution:* Gulf of California to Gorgona Island, Colombia; low water to 60 fms.

### *Ophiolepis fulva*<sup>3</sup> sp. nov.

Text-figure 3.

Disk 8 mm. in diameter, arms 21-23 mm. long. Disk flat, thin, rounded pentagonal or quite circular, covered as in *variegata* by relatively large plates, encircled by small ones; a notable peculiarity is that the central group of 6 plates (a central surrounded by 5 radials) is rarely symmetrical and never conspicuous; in many specimens it is quite indistinguishable. The arms are somewhat widened at the base but not much flattened; the upper arm plates are rounded hexagonal and, excepting the first 2 or 3, are as long as wide or longer, with nearly straight distal margin; the supplementary plates are relatively conspicuous. The side arm-plates are very large, longer than high, the distal margin not symmetrically semi-circular in outline but the lower half somewhat projecting and carrying 2 short, blunt,



Text-figure 3.

*Ophiolepis fulva*. Six arm segments, seen from the side.  $\times 14$ .

thick arm-spines, the upper one often the larger and longer. The under arm-plates are longer than wide, except the first half dozen, and the distal margin is definitely convex. Otherwise the oral surface is not evidently different from that of *variegata*, although the arms at disk margin are definitely less widened.

The color of the dorsal side is a mixture of browns and lighter shades, inextricably mingled. The general impression is fulvous. The arms are cross-banded on the upper surface, but there is no little diversity in the number, width and distinctness of the bands. There is no indication of red. The lower surface is tinted with yellow. Of course, the generally yellow-tinted color is not the most important specific character but it is quite obvious and as a rule is the most conspicuous feature. The side arm-plates and arm-spines are distinctive and the irregular plating of the disk and the narrow arm-bases are helpful characters.

Holotype, M.C.Z. No. 6049, from Zaca St. 195 D-13.

There are 152 paratypes, ranging from 1.5 to 8 mm. in diameter of disk. All the material is from St. 195 D-13, Port Guatulco, Mexico, 8 fms., sandy

<sup>3</sup> *fulvus*=brownish-yellow, tawny, in reference to the coloration.

bottom. There is great diversity in the relative quantity of light and dark browns, whites and creamy tints, some specimens being brighter or duller than the holotype, but the generally fulvous tint is notably different from the redder or grayer tints of other species.

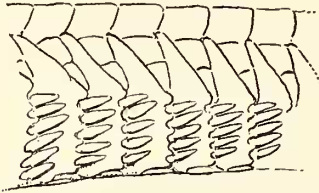
*Geographical Distribution*: Known only from the *Zaca* 1937-38 collecting.

***Ophiolepis grisea*<sup>4</sup> sp. nov.**

Text-figure 4.

Disk flat, pentagonal, 22 mm. in diameter. Arms 5, rather more than 100 mm. long or nearly 5 times the disk-diameter. In young individuals, 8-10 mm. across the disk, the arms are a trifle more than 4 times disk diameter.

The primary plates of the disk are very evident particularly in the smaller specimens. The central plate is usually noticeably smaller than the encircling ring of 5 radials. The arms are wide at the disk margin (6 mm. in holotype) but are well arched and not at all flattened basally. Upper arm-plates wider than long even far out on the arm; near the disk they are very short, 3-4 times as wide as long; supplementary plates, at least 2 on each side, extending far down on the sides of the arm. Side arm-plates high and short, carrying 4 or often 5, and sometimes, close to disk, 6 spines. These spines are relatively very small, flattened and sharp pointed; when 5 or 6 are present, the lowest and uppermost are smallest, the third from the bottom the longest; when 4 only are present, the lowest is smallest while the other 3 may be subequal, or the uppermost smallest. The longest scarcely exceeds one-half the side arm-plate. In the young specimens from St. 213,



Text-figure 4.

*Ophiolepis grisea*. Six arm segments, seen from the side.  $\times 7$ .

the arm-spines on the basal part of the arms are bristling, standing out at right angles from the arm, but in adults, all the spines are closely appressed to the side of the arms. Oral surface, even including the under arm-plates, much as in *variegata*. Color definitely gray, more or less marked on both disk and arms with lighter areas and with white spots or speckles. Under the lens, there are many blackish spots and markings evident on both disk and arms. Lower surface uniformly buffy white—not so near a real white as in *variegata*. The line of demarcation between the upper and lower surfaces is very sharply drawn on the sides of the arms, just above the uppermost arm-spine. The arm-spines are therefore all white. The arms are not really banded but at rather definite intervals there are transversely placed, somewhat elliptical areas, which distally become narrow light bands. Between these areas there are widely separated small white spots, 4-7 on each arm. In young individuals (less than 10 mm. across the disk) the banding of the arms is more definite and in most such specimens there is a large irregular light blotch on the disk, although this may be broken up into several small spots.

Holotype, M.C.Z. No. 6050, from *Zaca* St. 199 D-5.

There are 4 paratypes from the same station, 199 D-5, which is off Monypenny Point, Gulf of Fonseca, 7 fms., on a muddy bottom. These range from 16 to 24 mm. across the disk but call for no comment. From St. 199

<sup>4</sup> *griseus*=gray, in reference to the prevailing color.



D-7, there are 3 specimens, each of which deserves mention. This station, while in the Gulf of Fonseca, was in 6 fms. off La Union, El Salvador, and the bottom is described as "mud, mangrove leaves." The smallest specimen is 18 mm. across a square disk as it is symmetrically tetramerous. Its color is like those from off Monypenny Point but the buffy shade of the lower surface is deeper. A second specimen, 22 mm. across, has a similar pale buff lower surface but the upper side is a light sandy gray; the blotches and marks and arm-bands are as in the darker gray individuals. The third specimen, 23 mm. across, also has the pale buff lower surface, but the upper side has a definitely reddish cast, which makes the lighter gray blotches and arm-bands stand out more sharply than in any other specimen. One can but wonder whether the mangrove leaves in the mud were a factor in causing the brighter coloration.

From St. 213 D-6-9, off Cedro Island, Gulf of Nicoya, Costa Rica, 4-6 fms., mud, sand and shell, there are 15 specimens of *Ophiolepis*, 6-13 mm. across the disk, which are apparently the young of this fine species. The gray coloration with white or light gray markings on the disk and in narrow bands on the arms is like that of the adults and even in the smallest individual there are 4 arm-spines on some at least of the basal arm-segments, while in *variegata* of such a size there are usually but 2. The arms are noticeably slender and arched. The bristling arm-spines on the basal half of the arm are probably a result of sudden immersion in alcohol, and not a normal condition.

This large and handsome species was at first regarded as a form of *variegata* but the character and arrangement of the arm-spines, the coloration, and the longer arms preclude such a decision. The color suggests *plateia* Ziesenhene but the length and character of the arms set it off very decidedly from that species. There seems to be no doubt therefore that it must be recognized as a distinct species.

*Geographical Distribution*: Known only from the *Zaca* 1937-38 collecting.

#### ECHINOIDEA.

##### *Eucidaris thouarsii* (Agassiz & Desor).

*Cidaridaris thouarsii* Agassiz & Desor, 1846. *Ann. Sci. Nat.* (3), 6, p. 326.

*Eucidaris thouarsii* Döderlein, 1887. *Jap. Seeigel*, p. 42.

There are 10 specimens of this common urchin but only 2 are adult and none is full grown. They were collected at the following places:

Mexico, Manzanillo, 30 fms., 2 young.

Mexico, Sihuatanejo, 2 adults and 2 young.

Panama, Bahia Honda, 30-50 fms., 3 young.

*Geographical Distribution*: Lower California to Panama; also Cocos and Galápagos Islands; low water to 50 fms.

##### *Stylocidaridaris dubia* (H.L. Clark).

*Tretocidaridaris dubia* H.L. Clark, 1907. *Bull. M.C.Z.*, 51, p. 204.

*Stylocidaridaris dubia* Mortensen, 1909. *Ech. Deutsche Südp. Exp.*, p. 52.

There are 4 very fine adults of this rather uncommon cidarid, 35-40 mm. in test diameter, from St. 214 D-4, 14 miles south by east off Judas Point, Costa Rica, in 61 fms., and 41 young individuals, 5-25 mm. through the test, from St. 224 D-1-3, on Hannibal Bank, Panama, in 35-40 fms.

*Geographical Distribution*: Gulf of Panama to Gorgona Island, Colombia; 15-112 fms.

***Astropyga pulvinata* (Lamarck).**

*Cidarites pulvinata* Lamarck, 1816. *Anim. s. Vert.*, 3, p. 59.

*Astropyga pulvinata* Agassiz & Desor, 1846. *Ann. Sci. Nat.* (3), 6, p. 345.

There are 3 notable specimens of this very handsome sea-urchin. One from St. 232, off Gorgona Island, Colombia, 2-8 fms., sand, is probably the smallest specimen yet recorded; it is scarcely 4 mm. in diameter, with bright red interambulacra, brown-violet ambulacra, and white oral surface; the slender, fragile spines are 5 mm. long, pale yellowish-green banded with brown-violet. The other specimens are adult and were taken at St. 195 D-2, in Port Guatulco, Mexico, in 3 fms. on sand; the smaller is 85 mm. across, brown-violet above except for sharply defined, triangular areas on the distal portion of each intrambulacrum, which are light reddish-brown, and fade out into the very pale brown of the oral surface; the spines are pale green on the aboral side of the test, more nearly white orally, but prettily marked with numerous narrow rings (6-12) of dull violet. The larger specimen is 110 mm. across with the test colored much as in the smaller but the spines show little banding except at the very base of a few; orally they are nearly white but at the ambitus they become dull violet basally and dorsally most of the spines are violet, although some are white at the tip. Evidently the green tint which is so conspicuous on the spines of the young individuals tends to disappear with age.

*Geographical Distribution*: Gulf of California to Panama; low water to 36 fms.

***Arbacia incisa* (A. Agassiz).**

*Echinocidaris incisa* A. Agassiz, 1863. *Bull. M.C.Z.*, 1, p. 20.

*Arbacia incisa* H.L. Clark, 1913. *Bull. Amer. Mus. Nat. Hist.*, 32, p. 220.

There are 5 small specimens from St. 126 D-18, -19, southeast of Cedros Island, Lower California, 20-25 fms., notable only for their uniformly blackish color. They range from 6 to 23 mm. in test diameter.

*Geographical Distribution*: Lower California to Zorritos, Peru; also Galápagos Islands; low water to 29 fms.

***Lytechinus anamesus* H.L. Clark.**

H.L. Clark, 1912. *Mem. M.C.Z.*, 34, no. 4, p. 254.

A single small specimen, 18 mm. in diameter, taken at St. 126 D-13, off Cedros Island, Lower California, in 45 fms., is the only representative of this species, so characteristic of southern California.

*Geographical Distribution*: Santa Barbara, California, to Point San Bartolome Bay, Lower California, 30-60 fms.

***Lytechinus pictus* (Verrill).**

*Psammechinus pictus* Verrill, 1867. *Trans. Conn. Acad.*, 1, p. 301.

*Lytechinus pictus* H.L. Clark, 1912. *Mem. M.C.Z.*, 34, no. 4, p. 258.

This is another sea-urchin characteristic of southern California and the west coast of Mexico. It is represented in the *Zaca* collection by 10 very young specimens, 3.5-13 mm. in diameter, taken at St. 126 D-18 off Cedros Island, Lower California, in 20 fms. The relationship between *pictus* and *anamesus* is very close and it is not unlikely that the latter is only a

long-spined form of *pictus* characteristic of deeper water, for it ranges from 20 down to 113 fms. while *pictus* is characteristic of the more strictly littoral zone.

*Geographical Distribution*: Monterey, California, to Gulf of California; also Cocos Island; low water to 50 fms.

***Toxopneustes roseus* (A. Agassiz).**

*Boletia rosea* A. Agassiz, 1863. *Bull. M.C.Z.* 1, p. 24.

*Toxopneustes roseus* Mortensen, 1903. "*Ingolf*" *Ech.*, pt. 1, p. 136.

This large sea-urchin characteristic of the littoral zone of western Central America is represented by 3 specimens 65 to 80 mm. in diameter. The label says they were "flesh-colored" in life. They were taken at St. 222 D-3, in Bahía Honda, Panama, in 8 fms.

*Geographical Distribution*: Mazatlan, Mexico, to Port Utria, Colombia; low water to 30 fms.

***Strongylocentrotus purpuratus* (Stimpson).**

*Echinus purpuratus* Stimpson, 1857. *Crust. Ech. Pac. Shores N. Amer.*, p. 86.

*Strongylocentrotus purpuratus* A. Agassiz, 1872. *Rev. Ech.*, pt. 1, p. 165.

A specimen 45 mm. in diameter is undoubtedly a representative of this northern species. It was taken at Guadeloupe Island, off Lower California, Nov. 8, 1937, but the *Albatross* took *purpuratus* in 1911 near Cedros Island, which is somewhat further south.

*Geographical Distribution*: Puget Sound to Lower California; low water to 10 fms.

***Echinometra vanbrunti* A. Agassiz.**

A. Agassiz, 1863. *Bull. M.C.Z.*, 1, p. 21.

This well known Mexican sea-urchin was taken at the following places: Mexico: Sihuatanejo Bay, 1 very small specimen, 9 mm. long.

Nicaragua: Corinto, Cardon Island, tide pools, 2 small adults.

Costa Rica: Uvita Bay, under rocks on reef, 1 small adult.

*Geographical Distribution*: Lower California to San Francisco Bay, Ecuador; also Cocos and Galápagos Islands; low water to 10 fms.

***Clypeaster europacificus* H.L. Clark.**

H.L. Clark, 1914. *Mem. M.C.Z.*, 46, p. 27.

There are 5 representatives of this fine clypeastroid in the collection. Two large adults, 150 mm. long, yellow-green in color, and two young ones, 50 and 54 mm. long, dull purple above but nearly white underneath, were taken at St. 214 D-1, 14 miles south by east of Judas Point, Costa Rica, in 42-61 fms. on a muddy bottom. The fifth specimen is a very young one, only 14 × 13 mm.; the upper surface is light dull purple, with pale greenish spines, while the oral side is light greenish-yellow, almost white. It was taken at St. 224 D-1, -2, -3, on Hannibal Bank, 35-40 fms.

*Geographical Distribution*: Gulf of California to Panama; also Galápagos Islands; 7-56 fms.

**Clypeaster ochrus** H.L. Clark.

H. L. Clark, 1914. *Mem. M.C.Z.*, 46, p. 30.

There are 2 Clypeasters from St. 195 D-9, Port Guatulco, Mexico, 7 fms., green sand and shell, which are typical *ochrus* in form and tuberculation of the test, but differ so markedly in color that I have hesitated over calling them by that name. The test is reddish-white, most nearly white on the dorsal interambulacral areas, most nearly dull rose-red on the poriferous areas of the petals and on the oral surface. The spines are dirty white or pale greenish but often have a rosy-tinge and the terminal portion may be quite roseate or even dull-red. The smaller specimen,  $59 \times 55 \times 15$  mm., is more roseate than the larger,  $80 \times 73 \times 20$  mm. If this coloration is natural, and there is not the slightest reason for thinking it artificial, and should prove to be constant in any considerable group or area, it would warrant a varietal name because it is so conspicuously different from the usual color.

*Geographical Distribution*: Isabel Island, Mexico, to Port Utria, Colombia; low water to 30 fms.

**Clypeaster speciosus** Verrill.

Verrill, 1870. *Amer. Jour. Sci.* (2) 49, p. 95.

There are 2 small Clypeasters from St. 184 D-2, off Manzanillo, Mexico, 30 fms., which are best referred to this species. They are obviously young but in the form of the test and the character of the petals seem to be *speciosus*. The larger is  $65 \times 55 \times 17$  mm., the smaller  $44 \times 39 \times 11$ . They are yellow-brown in color, more brown above, quite yellow orally, especially the smaller one. The oral surface is rather flat but is distinctly depressed about the mouth. The petals are relatively narrow but well opened at the tip. The periproct is strictly marginal in both specimens but I have never seen any other case in *speciosus* although I have examined a number of specimens of which several were younger than these. Because of this position of the periproct and the light yellow-brown color, I have hesitated to call these young *Clypeaster speciosus* but I hesitate even more to consider them a "new" species.

*Geographical Distribution*: Lower California, also Cocos and Galápagos Islands; low water to 50 fms.

**Moira clotho** (Michelin).

*Moera clotho* Michelin, 1855. *Rev. Mag. Zool.*, p. 247.

*Moira clotho* A. Agassiz, 1872. *Rev. Ech.*, pt. 1, p. 147.

A superb series of this apparently rare spatangoid was taken at St. 213 D-2, off Cedro Island, Gulf of Nicoya, Costa Rica, in 4 fms. on a muddy bottom. There are 11 specimens ranging from 9 mm.  $\times 8 \times 6$  to a very fine adult,  $50 \times 45 \times 37$ . The two smallest specimens are more or less badly damaged but the others are in beautiful condition. All are pale fawn color, the fascioles and petals somewhat darker, the enlarged tips of the spines on the plastron, pure white.

*Geographical Distribution*: Lower California to Panama; low water to 10 fms.

***Plagiobrissus pacificus*<sup>5</sup> sp. nov.**

Plate II; figs. 3 &amp; 4.

Test elongated and flattened, 36 mm. long, 25 mm. wide and 11-12 mm. high. So similar to *P. grandis* of the West Indian region that it is difficult to feel sure what characters are specific and what are merely due to youthfulness. The smallest specimen available of *grandis* is nearly twice as large,  $63 \times 45 \times 23$  mm. The Pacific species seems to be flatter and more rounded anteriorly, but the only character shown which would seem to be surely specific is in the ventral ambulacra. In the West Indian species these ambulacra, on each side of the ventral plastron are extraordinarily narrow and the plastron, like the lateral interambulacra, is densely covered with tubercles; this is as true for the smallest as for the largest specimens. In the specimen from the Pacific, these ambulacra are comparatively wide and the plastron itself is narrower and less well-defined. This difference is best shown by the actual measurements. In the smallest *grandis*, measured across the middle of the ventral surface, we find the plastron is 14 mm. across, the bare ambulacra on each side, only 3 mm., and the lateral interambulacra (to test margin) 12.5 mm. In the type of *pacificus* the same measurements are 5, 3 and 7 mm. Thus in *pacificus*, the plastron is not equal in width to the two ambulacra while in *grandis* it is more than double their combined width; in *pacificus*, the ambulacra are almost half as wide as the lateral tuberculated areas but in *grandis* they are scarcely one-fourth as much. As a result of these differences the lower surface of *pacificus* looks quite unlike that of *grandis*. One can only speculate as to how much of this difference would persist in a *pacificus* 100 mm. long. The spines and pedicellariae in the two species are similar but only a few pedicellariae are to be seen in the specimen from the Pacific. One large tridentate with very narrow, widely divergent valves was found and 2 or 3 of the "long globiferous" can be seen near the posterior end of ambulacrum 5. A few very minute ophicephalous pedicellariae are to be seen among the ventral spines. The peristome in *pacificus* is relatively long and little depressed and the plates covering it are notably longer than wide; but these are very likely youthful rather than specific characters. The color of the specimen is very pale fawn, nearly white—the test dorsally is white.

Holotype, M.C.Z. No. 7625, from St. 224 D-1,-2,-3, on Hannibal Bank, Panama, in 35 fms.; in view of the character of the specimen and the known habits of the West Indian species, it is pretty certain that *pacificus* was secured in the third haul of the dredge, which was on a bottom of sand, shells and algae.

Besides the holotype, a second specimen was secured at the same time, but is so much younger, it is of no help in defining the species. It measures  $19 \times 14.5 \times 6.5$  mm. and shows the same wide ventral ambulacra as the holotype but even less well defined and more obviously youthful.

The discovery of this genus on the western coast of Central America is of the greatest interest. It furnishes another link connecting the Panamic with the West Indian fauna and is particularly interesting in showing that striking novelties are still to be found in the Panamic region in spite of the large amount of collecting and dredging that have been done there in the past forty years.

*Geographical Distribution*: Known only from the Zaca collection.

<sup>5</sup> *pacificus*, in reference to the habitat, all other members of the genus occurring in the Atlantic region or Mediterranean.

**Meoma grandis** Gray.

Gray, 1851. *Ann. Mag. Nat. Hist.* (2), 7, p. 132.

A single specimen of this spatangoid was taken at St. 195 D-16, in Port Guatulco, Mexico, 10 fms., sand. It measures  $98 \times 85 \times 48$  mm. and the color is a real brown.

*Geographical Distribution*: Gulf of California and west coast of Mexico, 20-60 fms.

**Lovenia cordiformis** A. Agassiz.

A. Agassiz, 1872. *Bull. M.C.Z.*, 3, p. 57.

A small specimen,  $35 \times 28 \times 14$  mm., of this typically southern Californian spatangoid, was taken at St. 126 D-19, southeast of Cedros Island, Lower California, in 25 fms. The color is definitely light brown.

*Geographical Distribution*: Santa Barbara, California, to Guayaquil, Ecuador; also Cocos, Galápagos and Hawaiian Islands.

## EXPLANATION OF THE PLATES.

## PLATE I.

Fig. 1. *Othilia aculeata* Gray. Aboral surface.  $\times 1.5$ .

Fig. 2. Oral surface.  $\times 1.5$ .

## PLATE II.

Fig. 3. *Plagiobrissus pacificus* sp. nov. Aboral surface.  $\times 2$ .

Fig. 4. Oral surface.  $\times 2$ .

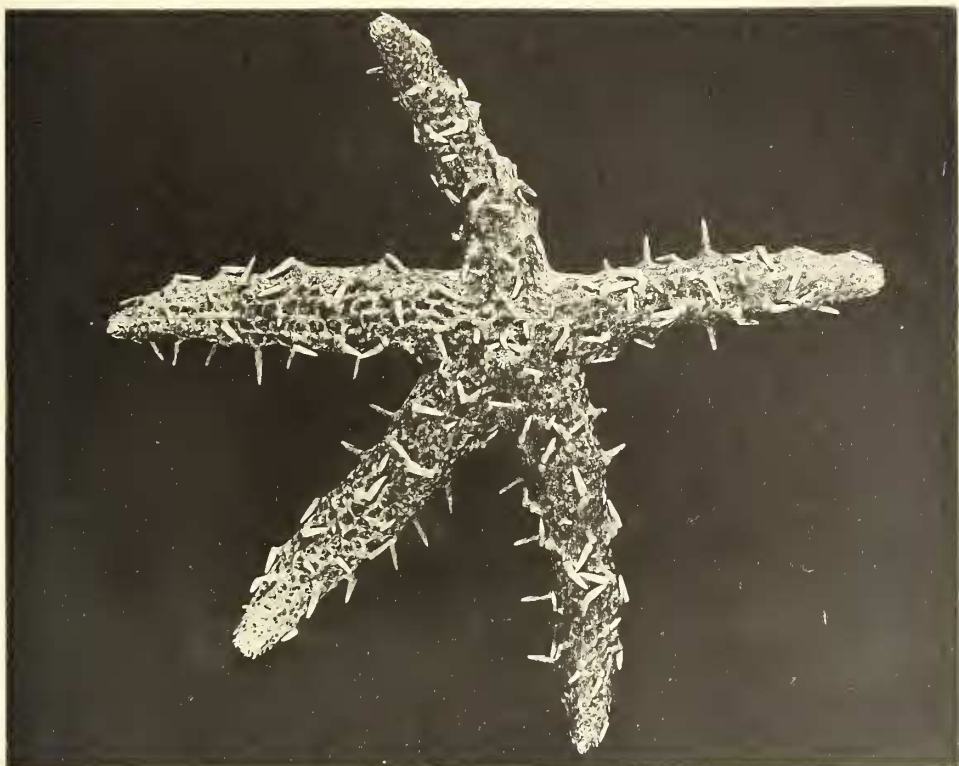


FIG. 1.

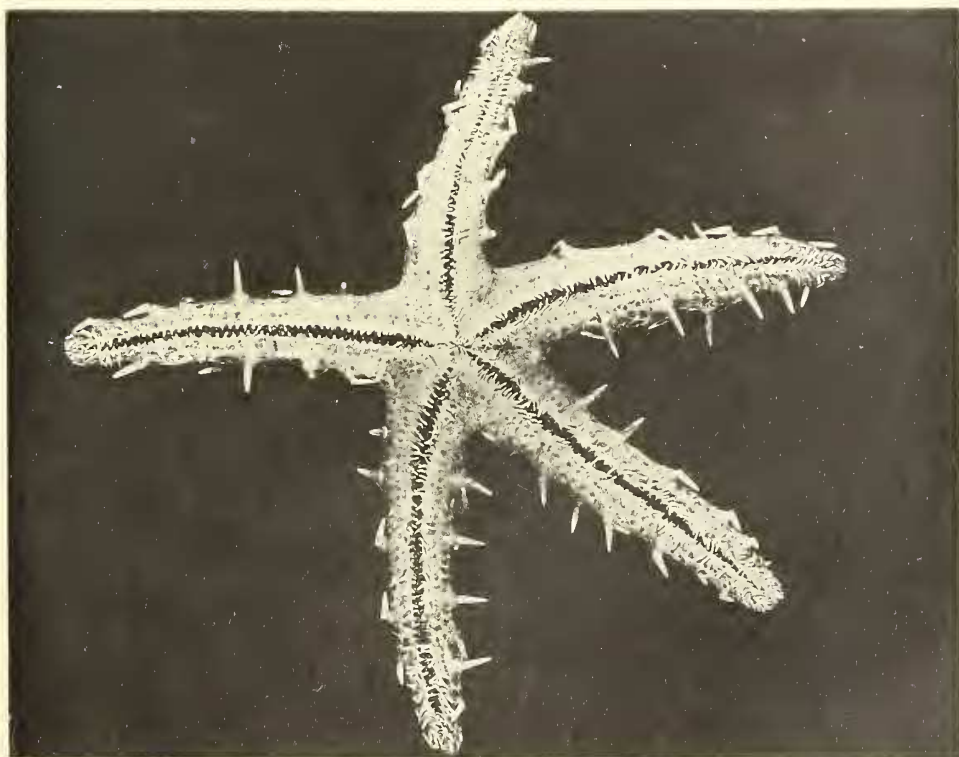


FIG. 2.

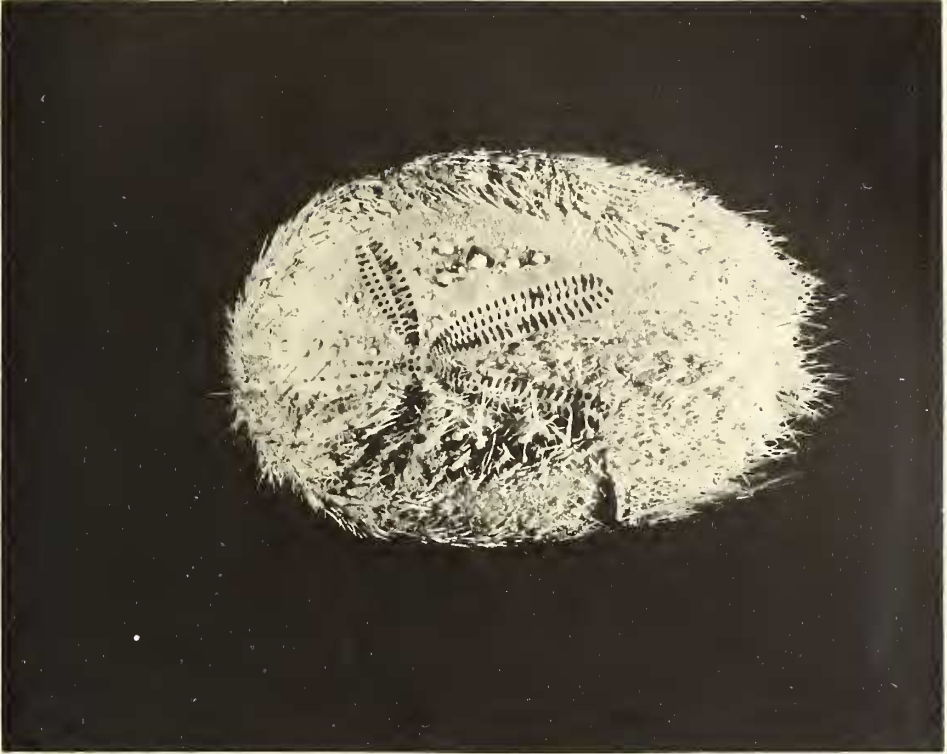


FIG. 3.

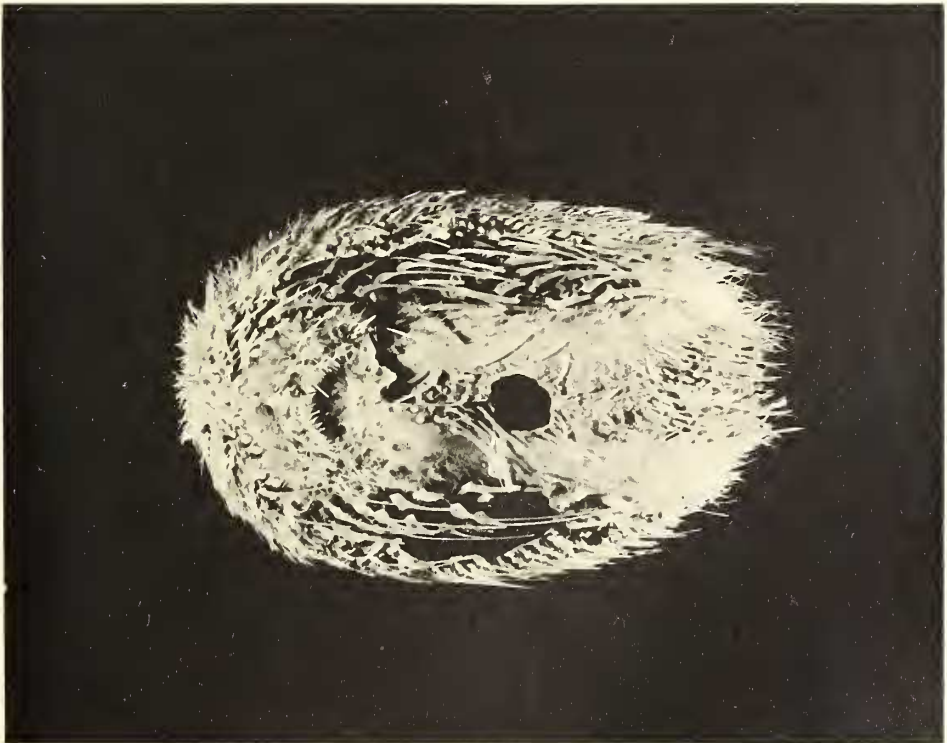


FIG. 4.